

(c) after (b), bleaching the chemical cellulose pulp in a second chlorine dioxide step; and

wherein (a) is further practiced so as to provide a chlorine dioxide dosage of between about 0.1-1.0% active chlorine during the first chlorine dioxide step; and wherein (c) is practiced so as to provide a chlorine dioxide dosage of between about 0.5-2.0% active chlorine during the practice of the second chlorine dioxide step.

40. A method as recited in claim 39 wherein (a) is further practiced so that the temperature in the first chlorine dioxide step is between about 80-100°C, and so that the treatment time in the first chlorine dioxide step is between 30 seconds – three minutes.--

#### REMARKS

A typographical error in the specification has been corrected. New claims have been presented all of which are in proper form, and clearly patentably distinguish from the art.

With respect to the 35 USC §112, second paragraph, rejection of claims 1 through 20 at the bottom of page 4 of the previous Action, it is respectfully submitted that the rejection is incorrect. The rejection is based upon the erroneous assumption (which apparently is also made in the art rejections) that the acid treating step (b) recited in original claim 1 is a second chlorine dioxide step. In fact it is not, it is solely an acid treating step, and the only chlorine dioxide that would be present would be any small residual amount of chlorine dioxide that was not completely consumed in step (a). Therefore referring to step (c) as a second chlorine dioxide step is entirely correct. It is noted that the fact that all of the steps are performed in a chlorine dioxide stage simply

means that there is no washing or thickening between the steps, as clearly illustrated in the exemplary embodiment in the drawing. Thus all of the claims are clearly in proper form within the purview of 35 USC §112.

Reconsideration is respectfully requested of the art rejections of claims based upon the WO 91/05909 reference (hereafter "the WO reference") Vuorinen et al, Histed et al, and Carles et al, made in the previous Action. None of the references are at all relevant to the claimed invention, and do not accomplish the advantageous results that are achieved according to the present invention.

When evaluating the rejection in the claimed invention, one thing should be kept in mind, and that is the difference between chlorine dioxide usage where it is expressed as a percentage of active chlorine, and where it is expressed as a percentage of chlorine dioxide with respect to the pulp. The conversion of chlorine dioxide given as a percentage of chlorine dioxide with respect to the pulp, such as provided in the WO reference, must be multiplied by 2.63 in order to get percentage of active chlorine. For example, in Table 3 of the WO reference, page 20 thereof, where the percentage of chlorine dioxide is given as 0.6, that is expressed as the percentage of  $\text{ClO}_2$  with respect to pulp, and must be multiplied by 2.63, which gives 1.58% active chlorine.

The present invention provides an alternative method of combining a hot acid step with a bleaching sequence utilizing chlorine dioxide. The invention provides a method which may be practiced in an economical manner, particularly in bleaching plants of existing pulp mills. In other words, the invention is capable of fitting chlorine

dioxide bleaching of pulp into a bleaching plant in an overall economical and environmentally acceptable manner.

The method of the invention is characterized in that the chlorine dioxide stage comprises successively at least a first chlorine dioxide step, and an acid treatment step, and that the pH of the first chlorine dioxide step is adjusted so that the final pH of the pulp in the first chlorine dioxide step is over 4. The conditions during the first chlorine dioxide step are such that the hexenuronic acid groups in the pulp do not react with chlorine dioxide.

It is known that hexenuronic acid groups are removed by hot acid treatment prior to chlorine dioxide treatment. According to the invention it has now been discovered that the  $\text{ClO}_2$  treatment can also be performed in a bleaching sequence before the hot acid treatment if reactions between the hexenuronic acid groups of the pulp and the chlorine dioxide are prevented. Thus, a D stage may comprise, successively, a D step and an A step. According to the method of the invention, the chlorine dioxide step of the DA stage is performed so as to have a final pH of over 4, preferably over 5. The highest desirable pH value at the end of the first  $\text{ClO}_2$  step is normally about 7. Conventionally, the final pH of the first or the second chlorine dioxide bleaching stage is less than 4, typically 1 - 3.5. Surprisingly, it has been found out that hexenuronic acids do not react with chlorine dioxide at the pH range of over 4 and thus no chemical is consumed by reactions with chlorine dioxide. Chlorine dioxide is reduced to chlorite but it does not decompose further. The chlorine dioxide dose in this step is about 0.1 - 1.5% active Cl

(1 - 15 kg active Cl/admt), preferably between about 0.5 - 1.0% active Cl (5 - 10 kg active Cl/admt).

In the acid treatment (A) step, the conditions are typically as follows:

- pH 2 - 5, preferably between 2.5 - 4;
  - temperature over 80°C, preferably between 90 - 110°C; and
  - time 30 - 300 minutes, preferably at least t minutes, where
- $$t = 0.5 \exp(10517/(T+273) - 24) \quad (t = 0.5 e^{((10517/(T+273)) - 24)}), \text{ in which } T \text{ (}^{\circ}\text{C)}$$

is the temperature of the acid treatment.

According to the invention, the temperature in the D step of the DA stage is preferably over 70°C, preferably over 75°C, most preferably between 80 - 100°C, which is higher than the temperature of a conventional D stage. Thus, the temperature in the D and the A steps is essentially the same and there is no special need to cool or to heat the pulp between the steps, which is advantageous for energy economy. However, the invention is not limited to high temperature in the D step, but rather the D step may also be performed at the conventional D step temperature of below 70°C.

The treatment time in the D step of the invention is short, less than 10 minutes, preferably 30 seconds to 3 minutes. Conventionally, the chlorine dioxide treatment time is over 30 minutes, even 120 minutes depending on the temperature and therefore a conventional D step requires its own reactor. The DA stage according to the invention may be practiced by performing the acid treatment in a reactor tower but because of the short retention time the D step preceding the A step may take place, for example, in the feed line of the A step tower. The pulp flowing in the line is heated to the desired

temperature, for example about 90°C, and chemicals, such as chlorine dioxide, and alkali or acid if necessary to adjust the pH, are mixed into the pulp. The pulp flows under these conditions for the required period, e.g. one minute, and subsequently, acid is added to the pulp and it is supplied into the acid tower.

By providing chlorine dioxide treatment before acid treatment according to the invention, the acid demand in the A step is reduced as the reactions of chlorine dioxide with the pulp lignin produce hydrochloric acid and organic acids as byproducts.

The WO reference takes an entirely different approach compared to the claimed invention and does not provide any suggestion for the invention or the advantages achieved thereby. The embodiment described on pages 8 and 9 of the WO reference, which is the embodiment referenced in the previous Action, teaches a two step chlorine dioxide bleaching process. In the first step chlorine dioxide is added to a wood pulp suspension and the suspension is subjected to a first treatment step for about 5-40 minutes with the pH between 6.0 and 7.5, with a reaction temperature of between about 55-85°C (most suitably about 70°C). After the initial step, the pulp mixture is acidified to an optimum end pH of 3.8 (e.g. between 1.9-4.2) and reaction time in the second step of two or more hours, at a temperature of between 55-85°C. [See pages 8, 9, and 22 of the WO reference.]

In other words, the WO reference teaches a D stage in which the pH is first maintained at a high level for a short time, and then at a conventional value (3.8) for a conventional time (e.g. preferably between 2.5-3.9 hours). The acidification necessary for the second step is an essential part of the D stage of the WO reference. The high

level of acidification can be derived from the high (compared to the invention) amounts of chlorine dioxide used in the WO reference which requires a significant amount of chlorine dioxide during the second step (for example see claim 23 of the WO reference). For example see the high level of chlorine dioxide in the first chlorine dioxide treatment illustrated, for example, in figure 4 of the WO reference for the first and second chlorine dioxide procedures D1 and D2, again keeping in mind that the percentage of chlorine dioxide along the X axis there must be multiplied by 2.63 to properly compare it to the value of chlorine dioxide according to the claimed invention here.

Thus the WO reference clearly and unequivocally does not teach the acid treating step (b) according to the claimed invention, as distinct from a second chlorine dioxide step (c). The acidification that occurs in the WO reference is simply an essential part of the D stage of the WO reference, therefore the WO reference in conventional symbols would be as  $DD_A$ , whereas according to the present invention the sequence is either DA (e.g. claim 21) or DAD (e.g. claim 26).

Not only does the WO reference not teach what is set forth in the claims herein, it does not teach the advantages of the claimed invention, or provide any reason why the invention would be utilized.

The purpose of the A treatment according to claim 21, for example, is the removal of hexenuronic acid so that the process is simplified, and the acid demand in the A step is reduced as the reactions of chlorine dioxide with the pulp lignin pursuant to the specific conditions set forth in the first D step produce hydrochloric acid and organic acids as by-products. Then when proceeding to the next D step after the A treatment,

no added acid is necessary, and since the acid treatment removes hexenuronic acids the amount of chlorine dioxide chemical required in the second D step is smaller than if the hexenuronic acids had not been removed.

This is vastly different than the WO reference, where (see page 2) it is clear that the entire sequences (CD) (EO) DED<sub>A</sub> (not DAD as according to, for example, claim 26) and consequently the hexenuronic acids which are removed in the A stage according to the claimed invention are already destroyed in the CD stage.

Thus, the WO reference does not teach (b) of any of the claims of the instant application, nor any reason why it would be provided (e.g. destroying hexenuronic acid groups), nor are numerous other limitations even remotely suggested thereby, nor is there any reason why the WO reference would be modified to provide the invention. Of course in order for there to be a *prima facie* case of obviousness there must be a reason why the reference would be modified to provide the invention, and the reason must be taught in the prior art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1598, 1599 (Fed. Cir. 1988); also see *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Here there is no reason within the prior art, since the WO reference does not even deal with the same proximate problem as the invention, nor does it suggest the advantages achievable according to the invention. Without dealing with the proximate problem or suggesting the advantages of the invention, there can be no *prima facie* case of obviousness. See *In re Shaffer*, 108 USPQ 326, 329 (CCPA 1956), wherein the court held:

"In fact, a person having the references before him who was not cognizant of appellant's disclosure would not be informed that the problem solved by

appellant ever existed. Therefore, can it be said that these references which never recognized appellant's problem would have suggested its solution? We think not, and therefore feel that the references were improperly combined since there is no suggestion in either of the references that they can be combined to produce appellant's result." (Emphasis added.)

Also see *In re Gordon*, 733, F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984):

"We are persuaded that the board erred in its conclusion of prima facie obviousness. ... The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification."

Thus all of the claims are clearly patentably over the WO reference.

The Vuorinen et al reference which has been added in the first full paragraph on page 3 of the Action does not remedy the deficiencies of the WO reference as far as teaching the invention set forth in the independent claims, therefore even if Vuorinen et al were modified and combined with the WO reference the claimed invention would not ensue. All that Vuorinen et al teach is that the acid treatment (for example set forth in (b) of the instant application claims) is known *per se*, something readily admitted in applicant's specification (see the paragraph bridging pages 3 and 4 of the specification). However the mere fact that acid treatment *per se* is known does not mean that it is obvious to use it willy-nilly in the WO reference. As described above, the WO reference requires the (CD) initial treatment which would destroy hexenuronic acids, yet provide a more complex and less desirable treatment sequence than that claimed herein. Therefore there would be no reason for one of ordinary skill in the art to provide the acid treatment of Vuorinen et al in the WO reference. Also such a treatment would be specifically contrary to the teachings of the WO reference, and it can never be considered obvious to go specifically against a reference's teachings in the name of



obviousness (see *In re Dow Chemical Co.*, 837 F.2d 469, 473, 5 USPQ2d 1529, 1532 (Fed. Cir. 1988)). Also see *In re Mercier*, 185 USPQ 774, 778 (CCPA 1975) wherein the Court held:

"The relevant portions of a reference include not only those teachings which would suggest particular aspects of an invention to one having ordinary skill in the art, but also those teachings which would lead such a person away from the claimed invention. See *In re Lunsford*, 53 CCPA 986, 357 F.2d 380, 148 USPQ 716 (1966). ... *Without the benefit of appellant's disclosure, a person having ordinary skill in the art would not know what portions of the disclosure of the reference to consider and what portions to disregard as irrelevant, or misleading.* See *In re Wesslau*, 53 CCPA 746, 353 F.2d 238, 147 USPQ 391 (1965)." [Emphasis added]

The Hiestad et al reference that has been added against some of the claims also clearly and unequivocally does not teach the invention. The claims against which the Hiestad et al reference has been applied call for the treatment time in the first chlorine dioxide step to be between 30 seconds-three minutes, an extremely short time, and vastly different than the time frame of 5-40 minutes provided in the WO reference. Therefore even if Hiestad et al did have a teaching of a first chlorine dioxide step at a treatment time of about 30 seconds-three minutes there would be no *prima facie* case of obviousness because providing such a treatment time would be specifically against the teachings of the WO reference, and could never be considered obvious. See *In re Dow Chemical Co.*, *supra*, *In re Mercier*, *supra*, and *Ex parte Hartmann*, 186 USPQ 366, 367 (Bd. App. 1974) wherein the Board held:

"Reynolds teaches neither partial nor complete orientation of filaments in the film matrix. More importantly however, Reynolds cannot properly be combined with Graham et al relative to the employment of continuous monofilaments, since to do so would destroy that on which the invention of Graham et al is based, namely, the use of very short fibers. We will not sustain this rejection." (Emphasis added.)

Further, however, the Hiestad et al reference does not teach a chlorine dioxide step according to the present invention. The two minute reaction time disclosed in Hiestad et al is for a (CD) stage as made clear by the entire Hiestad et al disclosure, including the bold statement immediately after the title on page 41 "In a well-equipped mill, a (CD) E (HD) sequence can give high brightness", the (CD) stage being the "chlorination stage" in the left hand columns of Table 1 on page 42 of Hiestad et al, the stage E being the extraction stage in the middle columns of Table 1, and the (HD) stage being the "hypochloride stage" in the right hand columns of Table 1 of Hiestad et al.

The Carles et al reference also is irrelevant to the claimed invention. Carles et al relate to a process for bleaching an oxygen or peroxide pre-oxidized paper pulp using a hot chlorination step with gaseous chlorine, an alkaline extraction step in the presence of an oxidizing agent of the hypochloride type, and then a chlorine dioxide step at a temperature of between about 60-90°C with a pH of between about 5 and 11 (see column 7, line 54 through column 8, line 23 of Carles et al). The conditions in Carles et al must be evaluated with the entire Carles et al sequence in mind, and one cannot select from Carles et al an arbitrary features of one procedure therein without consideration of what Carles et al teach, in toto, one of ordinary skill in the art. Thus there is no *prima facie* case of obvious. Further, Carles et al do not teach the chlorine dioxide steps between about 90-100°C as recited, for example, in instant application claim 38.


**Vuorinen et al**  
**Serial No. 09/262,912**

In conclusion, all of the claims are clearly in proper form and patentably distinguish from the art therefore early passage of the subject application to issue is earnestly solicited.

Should any small matters remain outstanding it is requested that the undersigned attorney be given a call so that such matters may be worked out and the application placed in condition for allowance without the necessity of another Action and amendment.

Respectfully submitted,

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